CR-BSI (CDC)
From: Nancy Moureau (nancy@piccexcellence.com)
Sent: Thursday, December 3, 2009
To: Centers for Disease Control
Subject: Recommendations for Draft Guidelines for Prevention of Intravascular Catheter Related Infections

12/03/2009

To HICPAC Committee Members:

My name is Nancy Moureau. I am a Vascular Access Specialist and IV Team member at Greenville Memorial Hospital in Greenville, SC, as well as an educator with PICC Excellence, Inc. I thank you for the opportunity to respond to the Recommendations for Prevention of Intravascular Catheter Related Infections.

Comments regarding the draft:
After a fairly extensive line by line comparison of the 2002 CDC Guidelines and the new 2009 CDC Draft Guidelines (comparison listed at the end) I have the following recommendations:

Recommendations/Suggestions for the 2009 CDC Guidelines for the prevention of CLABSIs:

(Key – Green highlighted section is part of the current 2002 Guidelines, purple section is the recommendation specific to the 2009 Drafted Guidelines)

A. Monitor the catheter sites visually or by palpation through the intact dressing on a regular basis, depending on the clinical situation of individual patients. If patients have tenderness at the insertion site, fever without obvious source, or other manifestations suggesting local or BSI, the dressing should be removed to allow thorough examination of the site (*1,191–193*). **Category IB**

This statement is not currently in the 2009 Draft. Daily monitoring of the insertion site is a key component to the reduction of catheter related infections and is listed as part of the Central Line Bundle and the 5 million lives Institute for Healthcare Improvement (IHI) campaign. Inclusion of determination of site necessity should also include visualization and palpation of the insertion site at least daily.

B. Encourage patients to report to their health-care provider any changes in their catheter site or any new discomfort. **Category II**

This statement is not currently in the 2009 Draft. The patient should be educated regarding their catheter site and possible signs of infection. The Joint Commission 2009 National Patient Safety Goals (NPSG) include and require increasing patient involvement with the care. The 2009 NPSG for Central Venous Catheters requires specific education to be established for patients and families. Education has demonstrated reduction in CR-BSI through education of medical and nursing staff and is beginning to be used more and more to increase compliance with practices such as handwashing (Cohran, Larson, Roach, Blane, & Pierce, 1996; Coopersmith, et al., 2002; McGuckin, et al., 1999; Sheretz, et al., 2000; D. Warren, Zack, Cox, Cohen, & Fraser, 2003; D. K. Warren, Cosgrove SE, & Sepkowitz KA, 2006).

E. When adherence to aseptic technique cannot be ensured (i.e., when catheters are inserted during a

medical emergency), replace all catheters as soon as possible and after no longer than 48 hours (*22,71,201,202*). **Category II**

It is standard practice within most hospitals to replace catheters inserted by Emergency Medical Services (EMS) within 24 hours of placement. This practice has been initiated as a result of the 2002 guidelines. Adherence to aseptic technique and use of disinfecting agents during the insertion procedure are the key components in the reduction of catheter related bloodstream infections. (Small, et al., 2008). This guideline from 2002 should be included in the 2009 Guidelines.

1. Evaluate the catheter insertion site daily, by palpation through the dressing to discern tenderness and by inspection if a transparent dressing is in use. Gauze and opaque dressings should not be removed if the patient has no clinical signs infection. If the patient has local tenderness or other signs of possible CRBSI, an opaque dressing should be removed and the site inspected visually. **Category II**

This statement is not currently in the 2009 Draft. Consistent with the above comment on daily assessment both visually and through palpation. Recommendation to include this in the 2009 Guidelines.

2. Remove peripheral venous catheters if the patient develops signs of phlebitis (e.g., warmth, tenderness, erythema, and palpable venous cord), infection, or a malfunctioning catheter (*66*). **Category IB**

This statement is not currently in the 2009 Draft. As a known precursor to infection, catheters with signs of phlebitis should be removed immediately (Maki & Ringer, 1991). This recommendation should remain in the 2009 Guidelines in an effort to provide policies to reduce catheter related blood stream infections.

A. Use a CVC with the minimum number of ports or lumens essential for the management of the patient (*251–254*). **Category IB**

This statement is not currently in the 2009 Draft. As is consistent with preventative practices and known increase of risk with multiple lumens and the SHEA Strategies, use of the least number of lumens should be recommended by the 2009 Guidelines (Dobbins, Catton, Kite, McMahon, & Wilcox, 2003; Marschall, et al., 2008). In an effort to provide recommendations to reduce and eliminate catheter related bloodstream infections, this recommendation should remain in the 2009 Guidelines.

D. Designate personnel who have been trained and exhibit competency in the insertion of catheters to supervise trainees who perform catheter insertion (*39,43,46,182,187,188*). **Category IA**

Recommendation should remain in the 2009 Guidelines. Anyone training to insert a central venous catheter needs to be supervised by someone who has already been trained and exhibits competency in aseptic insertion procedures. Following specific bundles and guidelines reduces the risk of infection in hospitals. The new trainee needs to be supervised by someone who is familiar with the procedures and understands that adherence to these aseptic principles is the key to reducing infections.

This is supported by the 2008 SHEA Guidelines which state (Marschall, et al., 2008):

> *i. CVC insertion should be observed by a nurse, physician, or other healthcare personnel who has received appropriate education to ensure that aseptic technique is maintained.*
>
> *b. These healthcare personnel should be empowered to stop the procedure if breaches in aseptic technique are observed.*

Additionally, SHEA Guidelines also state:

> *7. Individuals responsible for healthcare personnel and patient education are accountable for ensuring that appropriate training and educational programs to prevent CLABSIs are developed and provided to personnel, patients, and families.*

Thank you for the opportunity to submit comments on the Guidelines created to prevent infections. As an educator the CDC Guidelines to Prevent Intravascular Device Related Infections are foundational material that I endeavor to include in every presentation to promote awareness and understanding. Thank you for all your efforts in creating this document for improvement of practice and in the promotion of better patient outcomes!

Respectfully submitted,

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References:

Cohran, J., Larson, E., Roach, H., Blane, C., & Pierce, P. (1996). Effect of intravascular surveillance and education program on rates of nosocomial bloodstream infections. *Heart Lung, 25*, 161-164.

Coopersmith, C., Rebmann, T., Zack, J., Ward, M., Corcoran, R., Schallom, M., et al. (2002). Effect of an education program on decreasing catheter related bloodstream infections in the surgical intensive care unit. *Critical Care Medicine, January 30, 2002*(1), 59-64.

Dobbins, B. M., Catton, J. A., Kite, P., McMahon, M. J., & Wilcox, M. H. (2003). Each lumen is a potential source of central venous catheter-related bloodstream infection. *Crit Care Med, 31*(6), 1688-1690.

Maki, D., & Ringer, M. (1991). Risk Factors for Infusion-related Phlebitis with Small Peripheral Venous Catheters: A Randomized Controlled Trial. *Annals of Internal Medicine, 114*(10), 845-854.

Marschall, J., Mermel, L., Classen, D., Arias, K., Podgorny, K., Anderson, D., et al. (2008). Strategies to Prevent Central Line-Associated Bloodstream Infections in Acute Care Hospitals. *Infection Control and Hospital Epidemiology, 29*(1), S22 - S30.

McGuckin, M., Waterman, R., Porten, L., Bello, S., Caruso, M., Juzaitis, B., et al. (1999). Patient education model for increasing handwashing compliance. . *Am J Infect Control, 27*(4), 309-314.

Sheretz, R., Ely, E., Westbrook, D., Gledhill, K., Streed, S., Kiger, B., et al. (2000). Education of Physicians-in-Training Can Decrease the Risk for Vascular Catheter Infection. *Annals of Internal Medicine, 132*(8), 641-648.

Small, H., Adams, D. H., Casey, A., Crosby, C., Lambert, P., & Elliot, T. (2008). Efficacy of Adding 2% (w/v) Chlorhexidine Gluconate to 70% (v/v) Isopropyl Alcohol for Skin Disinfections Prior to Peripheral Venous Cannulation. *Infection Control and Hospital Epidemiology, 29*(10), 963 - 965.

Warren, D., Zack, J., Cox, M., Cohen, M., & Fraser, V. (2003). An educational intervention to prevent catheter-associated bloodstream infections in a nonteaching, community medical center. *Critical Care Medicine, 31*(7), 1959-1963.

Warren, D. K., Cosgrove SE, D. D., Zuccotti G, Climo MW, Bolon MK, Tokars JI, Noskin GA, Wong ES,, & Sepkowitz KA, H. L., Perl TM, Solomon SL, Fraser VJ. . (2006). A multi-center intervention to prevent catheter associated bloodstream infections. [Infection]. *Infection Control and Hospital Epidemiology, 27*(7), 662-669.

Comparison of 2002 vs. 2009 CDC Guidelines for the Reduction of CLABSIs

- **Items in black print represent recommendations as summarized in the 2002 CDC document in the order they appeared in that document.**
- **Items in green print represent same recommendations as summarized in the 2009 CDC document with changes highlighted in yellow.**
- **Items in red print represent the item by item summary of changes between the documents**
- **Items in green box represent recommendations in the 2002 document which were not addressed in the 2009 document.**
- **Items in purple box represent recommendations new to the 2009 document which were not in the original 2002 document.**

I. Health-care worker education and training

A. Educate health-care workers regarding the indications for intravascular catheter use, proper procedures for the insertion and maintenance of intravascular catheters, and appropriate infection control measures to prevent intravascular catheter-related infections (*39, 43, 45–47,182–187*). **Category IA**

1. Educate healthcare personnel regarding the indications for intravascular catheter use, proper procedures for the insertion and maintenance of intravascular catheters, and appropriate infection control measures to prevent intravascular catheter-related infections [53-61]. Category IA

- No change

B. Assess knowledge of and adherence to guidelines periodically for all persons who insert and manage intravascular catheters (*39,43,46,182,188*). **Category IA**

2. Periodically assess knowledge of and adherence to guidelines for all persons who are involved in the insertion and maintenance of intravascular catheters [53-61]. Category IA

- Added word 'periodically'
- Added 'who are involved'

C. Ensure appropriate nursing staff levels in ICUs to minimize the incidence of CRBSIs (*48,189,190*). **Category IB**

4. Ensure appropriate nursing staff levels in ICUs to minimize the incidence of catheter-related BSIs. Observational studies suggest a ratio of 2:1 in ICUs where nurses are managing patients with CVCs [75-77]. Category IB

- Added 'Observational studies suggest a ratio of 2:1 in ICUs where nurses are managing patients with CVCs.'

II. Surveillance

A. Monitor the catheter sites visually or by palpation through the intact dressing on a regular basis, depending on the clinical situation of individual patients. If patients have tenderness at the insertion site, fever without obvious source, or other manifestations suggesting local or BSI, the dressing should be removed to allow thorough examination of the site (*1,191–193*). **Category IB *****

B. Encourage patients to report to their health-care provider any changes in their catheter site or any new discomfort. **Category II**

C. Record the operator, date, and time of catheter insertion and removal, and dressing changes on a standardized form. **Category II**

D. Do not routinely culture catheter tips (*8,194,195*). **Category IA**

- **NO MENTION IN THE 2009 DRAFT REGARDING SURVEILLANCE TECHNIQUES**

III. Hand hygiene

A. Observe proper hand-hygiene procedures either by washing hands with conventional antiseptic containing soap and water or with waterless alcohol-based gels or foams. Observe hand hygiene before and after palpating catheter insertion sites, as well as before and after inserting, replacing, accessing, repairing, or dressing an intravascular catheter. Palpation of the insertion site should not be performed after the application of antiseptic, unless aseptic technique is maintained (*43,70,196–200*). **Category IA**

1. Perform hand hygiene procedures, either by washing hands with conventional antiseptic containing soap and water or with waterless alcohol-based hand rubs (ABHR). Hand hygiene should be performed before and after palpating catheter insertion sites as well as before and after inserting, replacing, accessing, repairing, or dressing an intravascular catheter. Palpation of the insertion site should not be

performed after the application of antiseptic, unless aseptic technique is maintained [58, 127-131]. Category IA

- Changed observe to perform
- Changed alcohol based gels or foams to alcohol based hand rubs

B. Use of gloves does not obviate the need for hand hygiene (*43,198,199*). **Category IA**

- **NO MENTION OF THIS IN THE 2009 DRAFT**

IV. Aseptic technique during catheter insertion and care

A. Maintain aseptic technique for the insertion and care of intravascular catheters (*22,71,201,202*). **Category IA**

2. Maintain aseptic technique for the insertion and care of intravascular catheters [25, 132-134]. Category IA

- No change

B. Wear clean or sterile gloves when inserting an intravascular catheter as required by the Occupational Safety and Health Administration Bloodborne Pathogens Standard. **Category IC**.

- **NO MENTION OF OSHA IN THE 2009 DRAFT**

Wearing clean gloves rather than sterile gloves is acceptable for the insertion of peripheral intravascular catheters if the access site is not touched after the application of skin antiseptics.

3. Wear clean gloves, rather than sterile gloves, for the insertion of peripheral intravascular catheters, if the access site is not touched after the application of skin antiseptics. Category IC

- No change

Sterile gloves should be worn for the insertion of arterial and central catheters (*201,203*). **Category IA**

4. Sterile gloves should be worn for the insertion of arterial, central, and midline catheters [25, 132-134]; and these gloves should be changed, if a catheter is being exchanged over a guidewire (thereby contaminating the gloves) and a new sterile catheter is then handled.

- Added 'sterile gloves should be worn for midline catheters
- New line added 'and these gloves should be changed, if a catheter is being exchanged over a guidewire (thereby contaminating the gloves) and a new sterile catheter is then handled. '

C. Wear clean or sterile gloves when changing the dressing on intravascular catheters. **Category IC**

4. Wear either clean or sterile gloves when changing the dressing on intravascular catheters. Category IC

- No change

V. Catheter insertion

Do not routinely use arterial or venous cutdown procedures as a method to insert catheters (*204–206*).

- **NO MENTION OF THIS IN THE 2009 DRAFT**

Category IA

VI. Catheter site care

A. Cutaneous antisepsis

1. Disinfect clean skin with an appropriate antiseptic before catheter insertion and during dressing changes. Although a 2% chlorhexidine based preparation is preferred, tincture of iodine, an iodophor, or 70% alcohol can be used (*73,75,207,208*). **Category IA**

2. Prepare clean skin site with a 2% chlorhexidine-based preparation before central venous catheter insertion and during dressing changes. If there is a contraindication to chlorhexidine, tincture of iodine, an iodophor, or 70% alcohol can be used as alternatives [140, 141]. Category IA

- Instead of chlorhexidine being preferred, it is now **recommended**

2. No recommendation can be made for the use of chlorhexidine in infants aged <2 months. **Unresolved issue**

3. No recommendation can be made for the safety or efficacy of chlorhexidine in infants aged <2 months. Unresolved issue

- Slight wording change

3. Allow the antiseptic to remain on the insertion site and to air dry before catheter insertion. Allow povidone iodine to remain on the skin for at least 2 minutes, or longer if it is not yet dry before insertion (*73,75,207,208*). **Category IB**

4. Allow povidone iodine to remain on the skin for at least 2 minutes or longer for the antibacterial properties to take effect, if it is not yet dry before catheter insertion. The antibacterial properties of chlorhexidine work on contact, and chlorhexidine does not require a minimum 2- minute drying time before proceeding. Catheter insertion may begin as soon as the chlorhexidine is dry [140, 141]. Category IB

- See changes highlighted above. More specific about when insertion can begin with chlorhexidine

4. Do not apply organic solvents (e.g., acetone and ether) to the skin before insertion of catheters or during dressing changes (*209*). **Category IA**

- **NO MENTION OF ORGANIC SOLVENTS IN 2009 DRAFT. ONLY TOPICAL ANTIBIOTIC OINTMENT OR CREAMS.**

VII. Catheter-site dressing regimens

A. Use either sterile gauze or sterile, transparent, semi-permeable dressing to cover the catheter site (*146,210–212*). **Category IA**

1. Use either sterile gauze or sterile, transparent, semi-permeable dressing to cover the catheter site [146-149]. Category IA

- No change

B. Tunneled CVC sites that are well healed might not require dressings. **Category II**

8. No recommendation can be made regarding the necessity for any dressing on well-healed exit sites of long-term cuffed and tunneled CVCs. Unresolved issue

- Changed from not required to no recommendation-unresolved issue

C. If the patient is diaphoretic, or if the site is bleeding or oozing, a gauze dressing is preferable to a transparent, semi-permeable dressing (*146,210–212*). **Category II**

2. If the patient is diaphoretic or if the site is bleeding or oozing, use gauze dressing until this is resolved [146-149]. Category II

- Requires gauze dressing rather than saying it's preferred

D. Replace catheter-site dressing if the dressing becomes damp, loosened, or visibly soiled (*146,210*). **Category IB**

3. Replace catheter site dressing if the dressing becomes damp, loosened, or visibly soiled [146, 147]. Category IB

- No change

E. Change dressings at least weekly for adult and adolescent patients depending on the circumstances of the individual patient (*211*). **Category II**

6. Replace dressings used on short-term CVC sites every 2 days for gauze dressings and at least every 7 days for transparent dressings, except in those pediatric patients in which the risk for dislodging the catheter may outweigh the benefit of changing the dressing [149]. Category IB

- Gives specific dressing change requirements based on type of dressing applied

F. Do not use topical antibiotic ointment or creams on insertion sites (except when using dialysis catheters) because of their potential to promote fungal infections and antimicrobial resistance (*107,213*). **Category IA** (See Central Venous Catheters, Including PICCs, Hemodialysis, and Pulmonary ArteryCatheters, in Adult and Pediatric Patients, Section II.I.)

4. Do not use topical antibiotic ointment or creams on insertion sites, except for dialysis catheters, because of their potential to promote fungal infections and antimicrobial resistance [150, 151]. Category IB

- No change

G. Do not submerge the catheter under water. Showering should be permitted if precautions can be taken to reduce the likelihood of introducing organisms into the catheter (e.g., if the catheter and connecting device are protected with an impermeable cover during the shower (*214,215*). **Category II**

5. Do not submerge the catheter or catheter site in water. Showering should be permitted if precautions can be taken to reduce the likelihood of introducing organisms into the catheter (e.g., if the catheter and connecting device are protected with an impermeable cover during the shower) [152, 153]. Category II

- No change

VIII. Selection and replacement of intravascular catheters

A. Select the catheter, insertion technique, and insertion site with the lowest risk for complications (infectious and noninfectious) for the anticipated type and duration of IV therapy (*22,55,59, 216–218*). **Category IA**

- **THIS STATEMENT NOT MADE IN 2009 DRAFT**

B. Promptly remove any intravascular catheter that is no longer essential (*219,220*). **Category IA**

11. Promptly remove any intravascular catheter that is no longer essential [108, 109]. Category IA

- No change

C. Do not routinely replace central venous or arterial catheters solely for the purposes of reducing the incidence of infection (*134,135,221*). **Category IB**

1. Do not routinely replace CVCs, PICCs, hemodialysis catheters, or pulmonary artery catheters to prevent catheter-related infections. Category IB

- Specifies each type of catheter individually

D. Replace peripheral venous catheters at least every 72–96 hours in adults to prevent phlebitis (*128*). Leave peripheral venous catheters in place in children until IV therapy is completed, unless complications(e.g., phlebitis and infiltration) occur (*174,175,222,223*). **Category IB**

1. Replace peripheral catheters every 72-96 hours to reduce risk of infection and phlebitis in adults.
2. Replace peripheral catheters in children only when clinically indicated [82, 83]. Category 1B
2. Replace midline catheters only when there is a specific indication. Category II

- Changed wording on when to replace catheters in children
- Added info on midline catheter replacement

E. When adherence to aseptic technique cannot be ensured (i.e., when catheters are inserted during a medical emergency), replace all catheters as soon as possible and after no longer than 48 hours (*22,71,201,202*). **Category II**

- **NO MENTION OF THIS IN THE 2009 REPORT**

F. Use clinical judgment to determine when to replace a catheter that could be a source of infection (e.g., do not routinely replace catheters in patients whose only indication of infection is fever). Do not routinely replace venous catheters in patients who are bacteremic or fungemic if the source of infection is unlikely to be the catheter (*224*). **Category II**

2. Do not remove CVCs or PICCs on the basis of fever alone. Use clinical judgment regarding the appropriateness of removing the catheter if infection is evidenced elsewhere or if a noninfectious cause of fever is suspected. Category II

- Deleted highlighted sentence

G. Replace any short-term CVC if purulence is observed at the insertion site, which indicates infection (*224,225*). **Category IB**

- **NO MENTION OF THIS IN THE 2009 REPORT**

H. Replace all CVCs if the patient is hemodynamically unstable and CRBSI is suspected (*224,225*). **Category II**

- **NO MENTION OF THIS IN THE 2009 REPORT**

I. Do not use guidewire techniques to replace catheters in patients suspected of having catheter-related infections (*134,135*). **Category IB**

4. Do not use guidewire exchanges to replace a non-tunneled catheter suspected of infection. Category IB

- Slight change in wording

IX. Replacement of administration sets*, needleless systems, and parenteral fluids

A. Administration sets

1. Replace administration sets, including secondary sets and add-on devices, no more frequently than at 72-hour intervals, unless catheter-related infection is suspected or documented (*23,149–151*). **Category IA**

1. In patients not receiving blood, blood products or lipid emulsions, replace administration sets, including secondary sets and add-on devices, no more frequently than at 96-hour intervals, [313] but at least every 7 days [255, 314-316]. Category IA

- Changed from 72 to 96 hours
- Specified 'In patients not receiving blood, blood products or lipid emulsions'

2. Replace tubing used to administer blood, blood products, or lipid emulsions (those combined with amino acids and glucose in a 3-in-1admixture or infused separately) within 24 hours of initiating the infusion (*158,226–229*). **Category IB**. If the solution contains only dextrose and amino acids, the administration set does not need to be replaced more frequently than every 72 hours (*226*). **Category II**

2. Replace tubing used to administer blood, blood products, or lipid emulsions (those combined with amino acids and glucose in a 3-in-1 admixture or infused separately) within 24 hours of initiating the infusion [317-320]. Category IB

- Removed highlighted section

3. Replace tubing used to administer propofol infusions every 6 or 12 hours, depending on its use, per the manufacturer's recommendation (*230*). **Category IA**

3. Replace tubing used to administer propofol infusions every 6 or 12 hours, when the vial is changed, per the manufacturer's recommendation (FDA website Medwatch) [321]. Category IA

- Added 'when the vial is changed

B. Needleless intravascular devices

1. Change the needleless components at least as frequently as the administration set (*160–162, 164–167*). **Category II**

1. Change the needleless components at least as frequently as the administration set. There is no benefit to changing these more frequently than every 72 hours [87, 328-334].

- Added 'There is no benefit to changing these more frequently than every 72 hours.'

2. Change caps no more frequently than every 72 hours or according to manufacturers' recommendations (*160,162,165,166*). **Category II**

2. Change caps no more frequently than every 72 hours for the purpose of reduced infection rates or according to manufacturers' recommendations [328, 330, 333, 334]. Category II

- Added 'for the purpose of reduced infection rates

3. Ensure that all components of the system are compatible to minimize leaks and breaks in the system (*163*). **Category II**

3. Ensure that all components of the system are compatible to minimize leaks and breaks in the system [335]. Category II

- No change

4. Minimize contamination risk by wiping the access port with an appropriate antiseptic and accessing the port only with sterile devices (*162,163,165*). **Category IB**

4. Minimize contamination risk by wiping the access port with an appropriate antiseptic (chlorhexidine preferred) and accessing the port only with sterile devices [330, 333, 335]. Category IA

- Recommends chlorhexidine as preferred antiseptic agent for wiping port

C. Parenteral fluids

1. Complete the infusion of lipid-containing solutions (e.g., 3-in-1 solutions) within 24 hours of hanging the solution (*156–158,226,229*). **Category IB**

11. Complete the infusion of lipid-containing solutions (e.g., 3-in-1 solutions) within 24 hours of hanging the solution [317, 318, 326, 327, 353] Category IB

- No change

2. Complete the infusion of lipid emulsions alone within 12 hours of hanging the emulsion. If volume considerations require more time, the infusion should be completed within 24 hours (*156–158*). **Category IB**

12. Complete the infusion of lipid emulsions alone within 12 hours of hanging the emulsion. If volume considerations require more time, the infusion should be completed within 24 hours [317, 326, 327]. Category IB

- No change

3. Complete infusions of blood or other blood products within 4 hours of hanging the blood (*231–234*). **Category II**

13. Complete infusions of blood or other blood products within 4 hours of hanging the blood [354-357]. Category II

- No change

4. No recommendation can be made for the hang time of other parenteral fluids. **Unresolved issue**

14. No recommendation can be made for the hang time of other parenteral fluids. Unresolved issue

- No change

X. IV-injection ports

A. Clean injection ports with 70% alcohol or an iodophor before accessing the system (*164,235,236*). **Category IA**

4. Minimize contamination risk by wiping the access port with an appropriate antiseptic (chlorhexidine preferred) and accessing the port only with sterile devices [330, 333, 335]. Category IA

- Changed antisepteic agent to 'chlorhexidine preferred'

B. Cap all stopcocks when not in use (*235*). **Category IB**

- **NO MENTION OF THIS IN 2009 DRAFT**

XI. Preparation and quality control of IV admixtures

A. Admix all routine parenteral fluids in the pharmacy in a laminar-flow hood using aseptic technique (*237,238*). **Category IB**

1. Mix all routine parenteral fluids in the pharmacy in a laminar flow hood using aseptic technique [347, 348]. Category IB

- No change

B. Do not use any container of parenteral fluid that has visible turbidity, leaks, cracks, or particulate matter or if the manufacturer's expiration date has passed (*237*). **Category IB**

2. Do not use any container of parenteral fluid that has visible turbidity, leaks, cracks, particulate matter, or if the manufacturer's expiration date has passed [348]. Category IB

- No change

C. Use single-dose vials for parenteral additives or medications when possible (*237,239*). **Category II**

3. Use single dose vials for parenteral additives or medications when possible [348, 349]. Category II

- No change

D. Do not combine the leftover content of single-use vials for later use (*237,239*). **Category IA**

4. Do not combine the leftover content of single use vials for later use [348, 349]. Category IA

- No change

E. If multidose vials are used
1. Refrigerate multidose vials after they are opened if recommended by the manufacturer.**Category II**

5. If multidose vials are used, refrigerate multidose vials after they are opened if recommended by the manufacturer [348].

- No change

2. Cleanse the access diaphragm of multidose vials with 70% alcohol before inserting a device into the vial (*236*). **Category IA**

6. Cleanse the access diaphragm of multidose vials with 70% alcohol before inserting a device into the vial [350]. Category IA

- No change

3. Use a sterile device to access a multidose vial and avoid touch contamination of the device before penetrating the access diaphragm (*235,240*). **Category IA**

7. Use a sterile device to access a multidose vial and avoid touch contamination of the device before penetrating the access diaphragm [351, 352]. Category IA

- No change

4. Discard multi-dose vial if sterility is compromised (*235,240*). **Category IA**

8. Discard multi-dose vial if sterility is compromised [351, 352]. Category IA

- No change

XII. In-line filters

Do not use filters routinely for infection-control purposes (*80,241*). **Category IA**

- **NOT MENTIONED IN 2009 REPORT**

XIII. IV-therapy personnel

Designate trained personnel for the insertion and maintenance of intravascular catheters (*46,47,210,242*). **Category IA**

3. Designate only trained personnel who demonstrate competence for the insertion and maintenance of peripheral and central intravascular catheters. [60-74]. Category IA

- Added 'who demonstrate competence

XIV. Prophylactic antimicrobials

Do not administer intranasal or systemic antimicrobial prophylaxis routinely before insertion or during use of an intravascular catheter to prevent catheter colonization or BSI (*97,98,108,243*). **Category IA**

Do not administer systemic antimicrobial prophylaxis routinely before insertion or during use of an intravascular catheter to prevent catheter colonization or CRBSI [188]**.** Category IA

- No change

Peripheral Venous Catheters, Including Midline Catheters, in Adult and Pediatric Patients

I. Selection of peripheral catheter

A. Select catheters on the basis of the intended purpose and duration of use, known complications (e.g., phlebitis and infiltration), and experience of individual catheter operators (*67,68,244*). **Category IB**

3. Select catheters on the basis of the intended purpose and duration of use, known infectious and non-infectious complications (e.g., phlebitis and infiltration), and experience of individual catheter operators [83-85]. Category IB

- Slight wording change

B. Avoid the use of steel needles for the administration of fluids and medication that might cause tissue necrosis if extravasation occurs (*67,68*). **Category IA**

4. Avoid the use of steel needles for the administration of fluids and medication that might cause tissue necrosis, if extravasation occurs [83-85]. Category IA

- No change

C. Use a midline catheter or PICC when the duration of IV therapy will likely exceed 6 days (*244*). **Category IB**

5. Use a midline catheter or peripherally inserted central catheter (PICC), instead of a short peripheral catheter, when the duration of IV therapy will likely exceed six days [83-85]. Category IB

- Added 'instead of short peripheral catheter'

II. Selection of peripheral-catheter insertion site

A. In adults, use an upper- instead of a lower-extremity site for catheter insertion. Replace a catheter inserted in a lower-extremity site to an upper-extremity site as soon as possible (*67,245*). **Category IA**

1. In adults, use an upper-extremity site for catheter insertion. Replace a catheter inserted in a lower extremity site to an upper extremity site as soon as possible [82, 83]. Category IB

- Category change from IA to IB

B. In pediatric patients, the hand, the dorsum of the foot, or the scalp can be used as the catheter insertion
site. **Category II**

2. In pediatric patients, the upper or lower extremities or the scalp can be used as the catheter insertion site [82, 83].

- Slight wording change for insertion sites

C. Replacement of catheter

1. Evaluate the catheter insertion site daily, by palpation through the dressing to discern tenderness and by inspection if a transparent dressing is in use. Gauze and opaque dressings should not be removed if the patient has no clinical signs infection. If the patient has local tenderness or other

signs of possible CRBSI, an opaque dressing should be removed and the site inspected visually. **Category II**

2. Remove peripheral venous catheters if the patient develops signs of phlebitis (e.g., warmth, tenderness, erythema, and palpable venous cord), infection, or a malfunctioning catheter (*66*). **Category IB**

3. In adults, replace short, peripheral venous catheters at least 72–96 hours to reduce the risk for phlebitis. If sites for venous access are limited and no evidence of phlebitis or infection is present, peripheral venous catheters can be left in place for longer periods, although the patient and the insertion sites should be closely monitored (*66,128,246*). **Category IB**

- **NONE OF THESE SPECIFICALLY MENTIONED IN 2009 DRAFT**

4. Do not routinely replace midline catheters to reduce the risk for infection (*131*). **Category IB**

2. Replace midline catheters only when there is a specific indication. Category II

- Slight change of wording

5. In pediatric patients, leave peripheral venous catheters in place until IV therapy is completed, unless a complication (e.g., phlebitis and infiltration) occurs (*174,175,222,223*). **Category IB**

2. Replace peripheral catheters in children only when clinically indicated [82, 83]. Category 1B

- Slight change of wording

III. Catheter and catheter-site care

Do not routinely apply prophylactic topical antimicrobial or antiseptic ointment or cream to the insertion site of peripheral venous catheters (*107,213*). **Category IA**

Use prophylactic antimicrobial lock solution in patients with long term catheters who have a history of multiple CRBSI despite optimal maximal adherence to aseptic technique [23, 211-228]. Category II

- Gives specifics of when to apply a prophylactic solution

Central Venous Catheters, Including PICCs, Hemodialysis, and Pulmonary Artery Catheters, in Adult and Pediatric Patients

I. Surveillance

A. Conduct surveillance in ICUs and other patient populations to determine CRBSI rates, monitor trends in those rates, and assist in identifying lapses in infection control practices (*3,12,16,247–250*). **Category IA**

B. Express ICU data as the number of catheter-associated BSIs per 1,000 catheter-days for both adults and children and stratify by birth weight categories for neonatal ICUs to facilitate comparisons with national data in comparable patient populations and health-care settings (*3,12,16,247–250*). **Category IB**

C. Investigate events leading to unexpected life-threatening or fatal outcomes. This includes any process variation for which a recurrence would likely present an adverse outcome (*13*). **Category IC**

- **NO SURVEILLANCE PRINCIPLES MENTIONED IN THE 2009 DRAFT**

II. General principles

A. Use a CVC with the minimum number of ports or lumens essential for the management of the patient (*251–254*). **Category IB**

- **NOT MENTIONED IN THE 2009 DRAFT**

B. Use an antimicrobial or antiseptic-impregnated CVC in adults whose catheter is expected to remain in place >5 days if, after implementing a comprehensive strategy to reduce rates of CRBSI, the CRBSI rate remains above the goal set by the individual institution based on benchmark rates (Table 2) and local factors. The comprehensive strategy should include the following three components: educating persons who insert and maintain catheters, use of maximal sterile barrier precautions, and a 2% chlorhexidine preparation for skin antisepsis during CVC insertion (*84–86,90,91,255*). **Category IB**

Use a chlorhexidine/silver sulfadiazine or minocycline/rifampin -impregnated CVC in adults whose catheter is expected to remain in place >5 days if, after successful implementation of a comprehensive strategy to reduce rates of CRBSI, the CRBSI rate remains above the goal set by the individual institution based on benchmark rates (Tables 2 and 3) and local factors. The comprehensive strategy should include at least the following three components: educating persons who insert and maintain catheters, use of maximal sterile barrier precautions, and a 2% chlorhexidine preparation for skin antisepsis during CVC insertion. Category IA

- Mentions specific anti-microbial agent

C. No recommendation can be made for the use of impregnated catheters in children. **Unresolved issue**

- **NOT MENTIONED IN THE 2009 DRAFT**

D. Designate personnel who have been trained and exhibit competency in the insertion of catheters to supervise trainees who perform catheter insertion (*39,43,46,182,187,188*). **Category IA**

- **NO MENTION IS MADE OF WHO SHOULD SUPERVISE TRAINEES IN THE 2009 DRAFT**

E. Use totally implantable access devices for patients who require long-term, intermittent vascular access. For patients requiring frequent or continuous access, a PICC or tunneled CVC is preferable (*256,257*).
Category II

F. Use a cuffed CVC for dialysis if the period of temporary access is anticipated to be prolonged (e.g., >3 weeks) (*144,258*). **Category IB**

G. Use a fistula or graft instead of a CVC for permanent access for dialysis (*142*). **Category IB**

H. Do not use hemodialysis catheters for blood drawing or applications other than hemodialysis except during dialysis or under emergency circumstances. **Category II**

I. Use povidone-iodine antiseptic ointment at the hemodialysis catheter exit site after catheter insertion and at the end of each dialysis session only if this ointment does not interact with the material of the hemodialysis catheter per manufacturer's recommendation (*103,114,144*). **Category II**

- **NONE OF THESE MENTIONED IN THE 2009 DRAFT**

III. Selection of catheter insertion site

A. Weigh the risk and benefits of placing a device at a recommended site to reduce infectious complications against the risk for mechanical complications (e.g., pneumothorax, subclavian artery puncture, subclavian vein laceration, subclavian vein stenosis, hemothorax, thrombosis, air embolism, and catheter misplacement) (*22,55,59,218*). **Category IA**

6. Weigh the risk and benefits of placing a central venous device at a recommended site to reduce infectious complications against the risk for mechanical complications (e.g., pneumothorax, subclavian artery puncture, subclavian vein laceration, subclavian vein stenosis, hemothorax, thrombosis, air embolism, and catheter misplacement) [25, 86-101]. Category IA

- Slight wording change

B. Use a subclavian site (rather than a jugular or a femoral site) in adult patients to minimize infection risk for nontunneled CVC placement (*22,55,59,60*). **Category IA**

7. Use a subclavian site, rather than a jugular or a femoral site, in adult patients to minimize infection risk for nontunneled CVC placement [25, 99, 100]. Category IA

- No change

C. No recommendation can be made for a preferred site of insertion to minimize infection risk for a nontunneled CVC (*61–63*). **Unresolved issue**

8. No recommendation can be made for a preferred site of insertion to minimize infection risk for a tunneled CVC. Unresolved issue

- No change

D. Place catheters used for hemodialysis and pheresis in a jugular or femoral vein rather than a subclavian vein to avoid venous stenosis if catheter access is needed (*259–263*). **Category IA**

9. Place catheters used for hemodialysis and pheresis in a jugular or femoral vein, rather than a subclavian vein, to avoid venous stenosis [101-105]. Category IA

- No change

IV. Maximal sterile barrier precautions during catheter insertion

A. Use aseptic technique including the use of a cap, mask, sterile gown, sterile gloves, and a large sterile sheet, for the insertion of CVCs (including PICCS) or guidewire exchange (*22,71*). **Category IA**

1. Use maximal sterile barrier precautions, including the use of a cap, mask, sterile gown, sterile gloves, and a large sterile full body drape, for the insertion of CVCs, PICCs, or guidewire exchange [60, 132, 136, 137]. Category IB

- Changed aseptic technique to maximal sterile barrier precautions
- Changed large sterile sheet to large sterile full body drape

B. Use a sterile sleeve to protect pulmonary artery catheters during insertion (*148*). **Category IB**

2. Use a sterile sleeve to protect pulmonary artery catheters during insertion [138]. Category IB

- No change

V. Replacement of catheter

A. Do not routinely replace CVCs, PICCs, hemodialysis catheters, or pulmonary artery catheters to prevent catheter-related infections (*132,134,135*). **Category IB**

1. Do not routinely replace CVCs, PICCs, hemodialysis catheters, or pulmonary artery catheters to prevent catheter-related infections. Category IB

- No change

B. Do not remove CVCs or PICCs on the basis of fever alone. Use clinical judgment regarding the appropriateness of removing the catheter if infection is evidenced elsewhere or if a noninfectious cause of fever is suspected (*224,264*). **Category II**

2. Do not remove CVCs or PICCs on the basis of fever alone. Use clinical judgment regarding the appropriateness of removing the catheter if infection is evidenced elsewhere or if a noninfectious cause of fever is suspected. Category II

- No change

C. Guidewire exchange

1. Do not use guidewire exchanges routinely for nontunneled catheters to prevent infection (*135,265*). **Category IB**

3. Do not use guidewire exchanges routinely for non-tunneled catheters to prevent infection. Category IB

- No change

2. Use a guidewire exchange to replace a malfunctioning nontunneled catheter if no evidence of infection is present (*135,265*). **Category IB**

4. Use a guidewire exchange to replace a malfunctioning non-tunneled catheter if no evidence of infection is present. Category IB

- No change

3. Use a new set of sterile gloves before handling the new catheter when guidewire exchanges are performed (*22,71*). **Category II**

5. Use new sterile gloves before handling the new catheter when guidewire exchanges are performed. Category II

- No change

VI. Catheter and catheter-site care

A. General measures

Designate one port exclusively for hyperalimentation if a multilumen catheter is used to administer parenteral nutrition (*266*). **Category II**

- **NO MENTION OF THIS IN 2009 DRAFT**

B. Antibiotic lock solutions

Do not routinely use antibiotic lock solutions to prevent CRBSI. Use prophylactic antibiotic lock solution only in special circumstances (e.g., in treating a patient with a long-term cuffed or tunneled catheter or port who has a history of multiple CRBSIs despite optimal maximal adherence to aseptic technique) (*115,116,267,268*). **Category II**

Use prophylactic antimicrobial lock solution in patients with long term catheters who have a history of multiple CRBSI despite optimal maximal adherence to aseptic technique [23, 211-228]. Category II

- Deleted 'Do not routinely use antibiotic lock …..'
- Limited to just patients with history of CRBSI

C. Catheter-site dressing regimens

1. Replace the catheter-site dressing when it becomes damp, loosened, or soiled or when inspection of the site is necessary (*65,146,211*). **Category IA**

3. Replace catheter site dressing if the dressing becomes damp, loosened, or visibly soiled [146, 147]. Category IB

- No change

2. Replace dressings used on short-term CVC sites every 2 days for gauze dressings and at least every 7 days for transparent dressings, except in those pediatric patients in which the risk for dislodging the catheter outweighs the benefit of changing the dressing (*211*). **Category IB**

6. Replace dressings used on short-term CVC sites every 2 days for gauze dressings and at least every 7 days for transparent dressings, except in those pediatric patients in which the risk for dislodging the catheter may outweigh the benefit of changing the dressing [149]. Category IB

- No change

3. Replace dressings used on tunneled or implanted CVC sites no more than once per week, until the insertion site has healed (*211*). **Category IB**

7. Replace dressings used on tunneled or implanted CVC sites no more than once per week, until the insertion site has healed [149]

- No change

4. No recommendation can be made regarding the necessity for any dressing on well-healed exit sites of long-term cuffed and tunneled CVCs. **Unresolved issue**

8. No recommendation can be made regarding the necessity for any dressing on well-healed exit sites of long-term cuffed and tunneled CVCs. Unresolved issue

- No change

D. No recommendation can be made for the use of chlorhexidine sponge dressings to reduce the incidence
of infection. **Unresolved issue**

11. Use a chlorhexidine-impregnated sponge dressing for temporary short-term catheters in patients older than 2 months of age, if the CRBSI rate is higher than the institutional goal, despite adherence to basic CRBSI prevention measures, including education and training, use of chlorhexidine for skin antisepsis, and MSB [22, 156-158]. Category 1B

- Recommends the use of chlorhexidine impregnated sponge dressing

E. Do not use chlorhexidine sponge dressings in neonates aged <7 days or of gestational age <26 weeks (*181*). **Category II**

11. Use a chlorhexidine-impregnated sponge dressing for temporary short-term catheters in patients older than 2 months of age, if the CRBSI rate is higher than the institutional goal, despite adherence to basic CRBSI prevention measures, including education and training, use of chlorhexidine for skin antisepsis, and MSB [22, 156-158]. Category 1B

- Recommends use of chlorhexidine sponge dressings in patients older than 2 months

F. No recommendation can be made for the use of sutureless securement devices. **Unresolved issue**

Use a sutureless securement device to reduce the risk of infection for PICCs [163]. Category II

- Change in recommendation. Issue resolved.

G. Ensure that catheter-site care is compatible with the catheter material (*109,110*). **Category IB**

9. Ensure that catheter site care is compatible with the catheter material [154, 155]. Category IB

- No change

H. Use a sterile sleeve for all pulmonary artery catheters (*148*). **Category IB**

10. Use a sterile sleeve for all pulmonary artery catheters [138]. Category IB

- No change

Additional Recommendations for Peripheral Arterial Catheters and Pressure Monitoring Devices for Adult and Pediatric Patients

I. Selection of pressure monitoring system

Use disposable, rather than reusable, transducer assemblies when possible (*269–273*). **Category IB**

7. Use disposable, rather than reusable, transducer assemblies when possible [294-298]. Category IB

- No change

II. Replacement of catheter and pressure monitoring system

A. Do not routinely replace peripheral arterial catheters to prevent catheter-related infections (*132,147, 221,274*). **Category II**

8. Do not routinely replace arterial catheters to prevent catheter-related infections [262, 276, 299, 300]. Category II

- No change

B. Replace disposable or reusable transducers at 96-hour intervals. Replace other components of the system (including the tubing, continuous-flush device, and flush solution) at the time the transducer is replaced (*22,270*). **Category IB**

9. Replace disposable or reusable transducers at 96-hour intervals. Replace other components of the system (including the tubing, continuous-flush device, and flush solution) at the time the transducer is replaced [25, 295]. Category IB

- No change

III. Care of pressure monitoring systems

A. General measures

1. Keep all components of the pressure monitoring system (including calibration devices and flush solution) sterile (*269,275–277*). **Category IA**

10. Keep all components of the pressure monitoring system (including calibration devices and flush solution) sterile [294, 301-303]. Category IA

- No change

2. Minimize the number of manipulations of and entries into the pressure monitoring system. Use a closed-flush system (i.e., continuous flush), rather than an open system (i.e., one that requires a syringe and stopcock), to maintain the patency of the pressure monitoring catheters (*272,278*). **Category II**

11. Minimize the number of manipulations of and entries into the pressure monitoring system. Use a closed flush system (i.e., continuous flush), rather than an open system (i.e., one that requires a syringe and stopcock), to maintain the patency of the pressure monitoring catheters [297, 304].

- No change

3. When the pressure monitoring system is accessed through a diaphragm rather than a stopcock, wipe the diaphragm with an appropriate antiseptic before accessing the system (*272*). **Category IA**

12. When the pressure monitoring system is accessed through a diaphragm, rather than a stopcock, wipe the diaphragm with an appropriate antiseptic before accessing the system [297]. Category IA

- No change

4. Do not administer dextrose-containing solutions or parenteral nutrition fluids through the pressure monitoring circuit (*272,279,280*). **Category IA**

13. Do not administer dextrose-containing solutions or parenteral nutrition fluids through the pressure monitoring circuit [297, 305, 306]. Category IA

- No change

B. Sterilization or disinfection of pressure monitoring systems

1. Use disposable transducers (*272,279–282*). **Category IB**

- **NOT MENTIONED IN 2009 DRAFT**

2. Sterilize reusable transducers according to the manufacturers' instructions if the use of disposable transducers is not feasible (*272,279–282*). **Category IA**

14. Sterilize reusable transducers according to the manufacturers' instructions if the use of disposable transducers is not feasible [297, 305-308]. Category IA

- No change

Recommendations for Umbilical Catheters

I. Replacement of catheters

A. Remove and do not replace umbilical artery catheters if any signs of CRBSI, vascular insufficiency, or thrombosis are present (*283*). **Category II**

1. Remove and do not replace umbilical artery catheters if any signs of CRBSI, vascular insufficiency, or thrombosis are present [278].

- No change

B. Remove and do not replace umbilical venous catheters if any signs of CRBSI or thrombosis are present (*283*). **Category II**

2. Remove and do not replace umbilical venous catheters if any signs of CRBSI or thrombosis are present [278]. Category II

- No change

C. No recommendation can be made for treating through an umbilical venous catheter suspected of being
infected. **Unresolved issue**

3. No recommendation can be made for treating through an umbilical venous catheter suspected of being infected. Unresolved issue

- No change

D. Replace umbilical venous catheters only if the catheter malfunctions. **Category II**

4. Replace umbilical venous catheters only if the catheter malfunctions. Category II

- No change

II. Catheter-site care

A. Cleanse the umbilical insertion site with an antiseptic before catheter insertion. Avoid tincture of iodine because of the potential effect on the neonatal thyroid. Other iodine-containing products (e.g., povidone-iodine) can be used (*75,177,178,284,285*). **Category IB**

5. Cleanse the umbilical insertion site with an antiseptic before catheter insertion. Avoid tincture of iodine because of the potential effect on the neonatal thyroid. Other iodine-containing products (e.g., povidone iodine) can be used [279-283]. Category IB

- No change

B. Do not use topical antibiotic ointment or creams on umbilical catheter insertion sites because of the potential to promote fungal infections and antimicrobial resistance (*107,213*). **Category IA**

6. Do not use topical antibiotic ointment or creams on umbilical catheter insertion sites because of the potential to promote fungal infections and antimicrobial resistance [150, 151]. Category IA

- No change

C. Add low doses of heparin (0.25–1.0 F/ml) to the fluid infused through umbilical arterial catheters (*286–288*). **Category IB**

7. Add low doses of heparin (0.25-1.0 U/ml) to the fluid infused through umbilical arterial catheters [284-286]. Category IB

- No change

D. Remove umbilical catheters as soon as possible when no longer needed or when any sign of vascular insufficiency to the lower extremities is observed. Optimally, umbilical artery catheters should not be left in place >5 days (*283,289*). **Category II**

8. Remove umbilical catheters as soon as possible when no longer needed or when any sign of vascular insufficiency to the lower extremities is observed. Optimally, umbilical artery catheters should not be left in place >5 days [278, 287]. Category II

- No change

E. Umbilical venous catheters should be removed as soon as possible when no longer needed but can be used up to 14 days if managed aseptically (*290,291*). **Category II**

9. Umbilical venous catheters should be removed as soon as possible when no longer needed, but can be used up to 14 days if managed aseptically [288, 289]. Category II

- No change

The following items are included in the 2009 Draft but don't appear to be included in the 2002 Recommendations:

Staffing

Observational studies suggest a ratio of 2:1 in ICUs where nurses are managing patients with CVCs [75-77]. Category IB

Recommendations for central venous catheters

10. Use ultrasound guidance to place central venous catheters to reduce the number of cannulation attempts and mechanical complications if this technology is available [106, 107].

Hand Hygiene and Aseptic Technique

and these gloves should be changed, if a catheter is being exchanged over a guidewire (thereby contaminating the gloves) and a new sterile catheter is then handled.

Skin Preparation Recommendations

1. Prepare clean skin with 70% alcohol before peripheral venous catheter insertion [139]. Category IA

Patient Cleansing Recommendation

Use a 2% chlorhexidine wash daily to reduce CRBSI [162]. Category II

Anticoagulants Recommendation

Do not routinely use anticoagulant therapy to reduce the risk of catheter-related infection in general patient populations [234]. Category II

Peripheral Arterial Catheters and Pressure Monitoring Devices for Adult and Pediatric Patients Recommendations

1. In adults, use of the radial, brachial or dorsalis pedis sites is preferred over the femoral or axillary sites of insertion to reduce the risk of infection [94, 95, 292, 293].
2. In children, the brachial site should not be used. The radial, dorsalis pedis, and posterior tibial sites are preferred over the femoral or axillary sites of insertion [94]. Category II
3. A cap, mask, sterile gloves and a large sterile fenestrated drape should be used during peripheral arterial catheter insertion [95, 293]. Category IB
4. During axillary or femoral artery catheter insertion, maximal sterile barriers precautions should be used. Category II
5. Replace arterial catheters only when there is a clinical indication. Category II
6. Remove the arterial catheter as soon as it is no longer needed. Category II

Needleless Intravascular Catheter Systems Recommendations

5. Use a needleless system to access IV tubing. Category IC
6. When needleless systems are used, the split septum valve is preferred over the mechanical valve due to increased risk of infection [336-339]. Category II

Multidose Parenteral Medication Vials and Parenteral Fluids Recommendations

9. All multidose vials should be dated when 1st used and thereafter not used beyond the manufacturer's stated expiration period. Category IC

10. Use the needle and syringe to access the multidose vial only once and to then discard both safely. This applies to each and every dose withdrawn from the vial [351, 352]. Category IA